The Scablands and the Grand Coulee Area: Glacial Lake Missoula Revisited

Paper Written by: Tait Rocksund

As an aspiring geologist, there is nothing more exciting than the opportunity to spend a few hours in the field exploring rock formations and geologic processes. Geology, the study of Earth’s lithospheric processes and structures, is extremely dynamic. “Geology is a study about what happened in the past and what is happening now – a study that increases our understanding of nature and our place in it,” (Hamblin & Christiansen, 2004, p.4). As a native to northwest Montana, I have always been interested glaciers. Glacial Lake Missoula, a lake formed by a glacial dam that existed roughly 15,000 years ago, is one of Montana’s most interesting pieces of geologic history (aside from the Belt formations clearly visible in Glacier National Park). Glacial Lake Missoula’s ice dam broke suddenly releasing a massive amount of water across eastern and central Washington. The ice dam on Glacial Lake Missoula would reform and release epic floods numerous times. It is widely accepted that approximately 13,000 years ago, the largest of these floods occurred. However, “because the glaciers advanced several times into the region, such catastrophic flooding probably occurred many times, perhaps as far back as 2.5 million years ago,” (p.410). In an effort to spend a day exploring Geology in an area of particular interest, I set out to observe the area carved out by these massive floods by Glacial Lake Missoula in eastern Washington, commonly referred to as the “scablands”. My field observations and the geologic history of eastern Washington, particularly in the Soap Lake/Ephrata area, will be examined in this research report.

During my time in the Soap Lake, Washington area, the primary type of rock that I observed was igneous. Igneous rock is one of three major types of rock found in Earth’s continental lithosphere; the other two types are metamorphic and sedimentary. Igneous rock is the type of rock that is formed through volcanic events. Generally, with igneous rock, the rock is contacted by magma or lava altering its chemical and physical composition. Magma can be defined as liquid rock within Earth’s interior (below the surface of Earth’s crust) and lava can be defined as liquid rock, or magma, that has erupted onto the surface of Earth’s crust. Magma is primarily composed of certain elements including “oxygen (O), silicon (Si), aluminum (Al), calcium (Ca), sodium (Na), potassium (K), iron (Fe), and magnesium (Mg),” (pg. 83). The elements in the rock, the rate of cooling of the rock, and the percent compositions of certain elements in the rock will ultimately determine what type of igneous rock will be formed. Furthermore, igneous rock is characterized by crystalline structures within the rock. The rate of cooling of igneous rock will determine the size of the crystals of the rock. The faster the cooling of the igneous rock after the volcanic event, the smaller the crystals; igneous rocks that cool slowly will have larger crystals in the rock’s structure. Igneous rocks with small crystals are referred to as being “fine-grained” and igneous rocks with large crystals are referred to as being “coarse-grained”. Grain size is one of the most important factors in discriminating between types of igneous rocks.

The majority of the igneous rock that I observed in the Soap Lake area was primarily basalt. Basalt is an igneous rock that is the primary constituent of the oceanic lithosphere. Basalt can be classified according to a few of its properties, including its texture. Basalt has an aphanitic texture. An igneous rock with aphanitic texture means that the crystals within the rock are “extremely fine-grained”, (p.86). Basically, an aphanitic texture means that the rock has almost undetectable crystals in it as seen by the naked eye. However, when viewed under a microscope, “many crystals of feldspar and quartz are recognizable,” (p.86). Basalt is mafic in character, meaning it is an igneous rock that rich in magnesium (Mg) and iron (Fe). Therefore, as with most mafic rocks/lava, basalt is dark in color. Furthermore, basalt is the most common type of extrusive igneous rock.

In eastern Washington, one can find the Columbia Plateau. The Columbia Plateau is a large area that has been formed through significant flood basalt events. “Flood basalts are some of Earth’s most impressive volcanic deposits; single flows can be traced for hundreds of kilometers,” (p.95). Flood basalts result from large-scale eruptions of basaltic lava, which generally results in numerous layers of basalt rocks (p.96). Shield volcanoes are responsible for flood basalts. Shield volcanoes can be classified as a volcano having a very low angle on its slope (less than a ten degree angle) (p.96). Although I was unable to witness the precise location of the shield volcano that erupted the sheets of basalt that I observed in the Columbia Plateau, the basalt rocks were evident throughout the “Grand Coulee” area, which was carved out by the massive flood events caused by Glacial Lake Missoula.

Interestingly enough, the distinct basalt rock formations carved out by Glacial Lake Missoula are certainly very unique. The enormous release of water was “barely diverted by pre-existing shallow valleys, scouring out channels and forming giant ripple marks, bars, and other sediment deposits,” (p.410). One of the most notable features of the basalt that was exposed by this massive flood of water is the columnar-jointing that is obvious in the basalt. See Figure 1 below for a visual of the columnar-jointing observed in basalt rock carved out by Glacial Lake Missoula.



“As [basaltic] flow cools, it contracts and may develop a system of polygonal cracks, known as columnar joints,” (p.95). As seen in the picture, columnar joints formed in the Columbia Plateau were cooled due to their proximity to water. Water, which has an extremely high specific heat, resists heating in a very notable way (specific heat of a substance is measured in terms of how much a substance resists change in temperature). Therefore, water can “hold” cooler temperatures and has an amazing cooling effect on hot substances, as observed in basalt flows.

In one location, known as the “Dry Falls”, the water from the flood coursed over a huge cliff of basalt, forming one of the largest waterfalls to ever grace North America. Within this area, multiple layers of basalt can be witnessed. The Dry Falls, which is now a state park in Washington, is over 350 feet tall and over 3 miles wide; this is significantly larger than the current state of Niagara Falls. Clearly evident in the Dry Falls area and Banks Lake area (a large lake that sits in the canyon carved out by the flood of Glacial Lake Missoula) are massive slopes of talus that extend down from the basalt cliffs. This is precisely what talus is, a field of rocks that accumulate at the base of large cliffs. See Figure 2 below for a picture of the “Dry Falls”.



As I drove into the Soap Lake area from Moses Lake, it was quite strange to see extremely large boulders sitting in the middle of what appears to be endless plains. It beckons the question, “How did those house-sized boulders make it into those fields?” I suppose that this is a question that enters into almost any person’s mind as they venture into the scablands region. Some of the rocks observed in the scablands are mudstones (most likely Appikunni or Grinnell) that are from the Belt formation, a group of sedimentary rocks exposed in the faults that exist along the Rocky Mountain seen in Glacial National Park. How could rocks from northwest Montana end of hundreds of miles away? An epic flood seems to be the most logical conclusion. These large boulders are called erratics. “Erratics are large boulders transported by glaciers and then dropped far from their point or origin,” (p.397). See figure 3 below for a picture of erratics observed in the eastern Washington scablands.



While in the Grand Coulee area, there was also another notable igneous rock formation, large boulders of granite. “Granite is a coarse-grained igneous rock composed predominantly of feldspar and quartz,” (p.89). Granite is significantly less dense compared to basalt. This explains how granite rises above basalt to form most of the continental crust. Due to granite’s density, it is more buoyant than basalt. Therefore, granite will generally sit above basalt. However, in the north end of the Grand Coulee, the granite layer was already solidified and no longer in a state that would allow it to flow and rise above the basalt that was flooding over it during the large scale basalt flows. Therefore, in a parcel of land called Steamboat Rock State Park, which is located toward the northern part of the Grand Coulee, one can find large granite boulders sitting beneath the basalt cliffs. Interestingly enough, the granite boulders are rounded due to process called “spheroidal weathering”. Spheroidal weathering occurs because “weathering attacks an exposed rock from all sides at once, and decomposition is most rapid along the corners and edges of the rock,” (p.262). The round granite boulders provide an interesting contrast to the columnar-joint fractures evident in the basalt cliffs directly above the granite. See Figure 4 below for a picture of spheroidal weathering in granite below columnar-jointed basalt in the Grand Coulee.



More spheroidal weathering in granite in Figure 5.



The Grand Coulee area, while almost exclusively known for its unique columnar-jointed basalt cliffs and steep canyons carved out by Glacial Lake Missoula, demonstrates the capacity of natural geologic processes to carve out breath-taking landscapes. The “scablands” in eastern Washington were certainly a unique landscape to observe for this project. The Earth has a story that can be seen in its landscape. Through the discipline of Geology, we can tell this story. Geology seeks to understand Earth’s history and its future. While future events cannot be foretold, through Geology, at least we can understand what might be in the future. Thanks Charles Lyell.

References:

Hamblin, W. K. & Christiansen, E. H. (2004). *Earth’s Dynamic Systems* (10th Ed.). Upper Saddle River, New Jersey: Prentice-Hall, Inc.